



UNIVERSE

Parcham Classes

# THE GREAT PERSONS WHO EXPLORED THE UNIVERSE



- In the ancient times, the knowledge about the universe was vague and confined to mystery and religious perceptions.

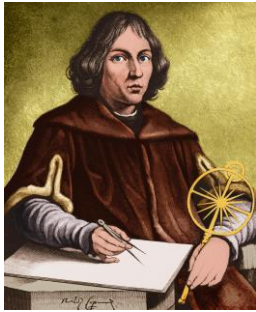
- In 140 AD, Ptolemy propounded the theory that the Earth was the centre of the universe and the sun and other heavenly bodies revolve around it.

- In 1543, Copernicus argued that the sun and not the earth was the centre of the universe. He created the universe with the solar system.

- Kepler supported Copernicus but said that the sun was the centre of the solar system and not the universe.

- Herschel made it clear that the solar system was a part of the much larger system of stars is called galaxy.

- Edwin Hubble in 1924 first demonstrated existence of galaxies beyond Milky way.



## THE BIG BANG THEORY

- The best-supported theory of our universe's origin centers on an event known as the **Big Bang Theory**.
- This theory was born of the observation that other galaxies are moving away from our own at great speed in all directions, as if they had all been propelled by an ancient explosive force.
- It suggests that about 1370 crore (13.7 billion) years ago, all matter and energy in the universe was concentrated into an area smaller than an atom. At this instant, matter, energy, space and time were not existent. Then suddenly with a bang, the Universe began to expand at an incredible rate and matter, energy, space and time came into being. As the Universe expanded, matter began to coalesce into gas clouds and the stars and planets.

## SOME TERMS WE SHOULD KNOW

- **Cosmos** : Another word for the universe.
- **Cosmic** : Relating to the universe or cosmos.
- **Cosmology** : The science of the origin and development of the universe.
- **Astronomy** : the scientific study of celestial objects (stars, planets etc.)
- **Celestial Body** : Celestial Body is any natural object outside of the Earth's atmosphere. Simple examples are the Moon, Sun, and the other planets of our solar system.
- **Constellations** : A constellation is an area on the celestial sphere in which a group of visible stars forms a perceived outline or pattern, typically representing an animal, mythological person or creature, or an inanimate object.

## MISCELLANEOUS FACTS

1. Big Bang Theory : George Lemaitre.
2. Father of Geography : Eratosthenes.
3. Father of modern Geography : Alexander von Humboldt.

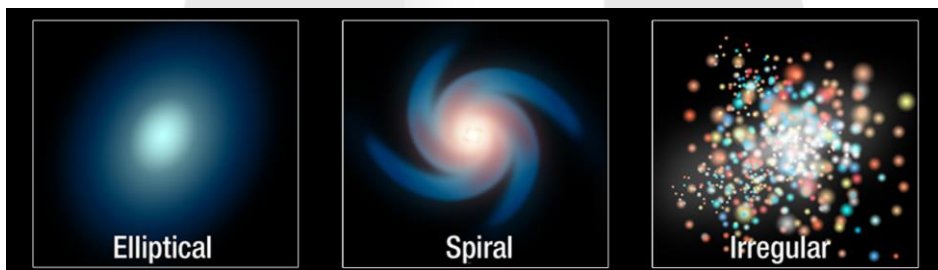
## GALAXY

Galaxy is a system of millions or billions of stars, together with gas and dust, held together by gravitational attraction.

They are the major building blocks of the universe.

Astronomers classify galaxies into three major categories : ***Elliptical***, ***Spiral*** and ***Irregular***.

These galaxies span a wide range of sizes, from dwarf galaxies containing as few as 100 million stars to giant galaxies with more than a trillion stars.



## OUR GALAXY (THE MILKY WAY)

The Milky Way (or Akash Ganga) is the galaxy that hosts our solar system.

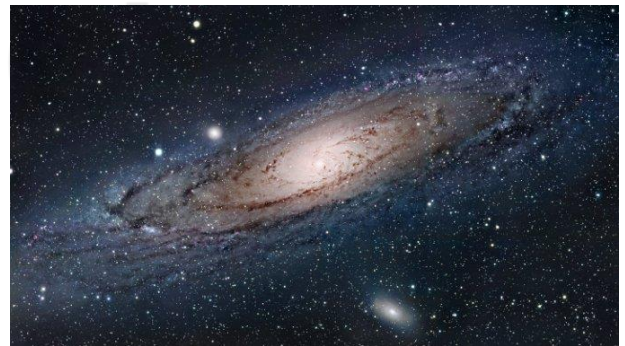
It is a Spiral galaxy and shaped like a flat disc with a central bulge.

It is estimated to contain 100-400 billion stars.

The Solar System is located in the **Orion Arm**, **26,000 light years from the centre** of the Milky Way galaxy.

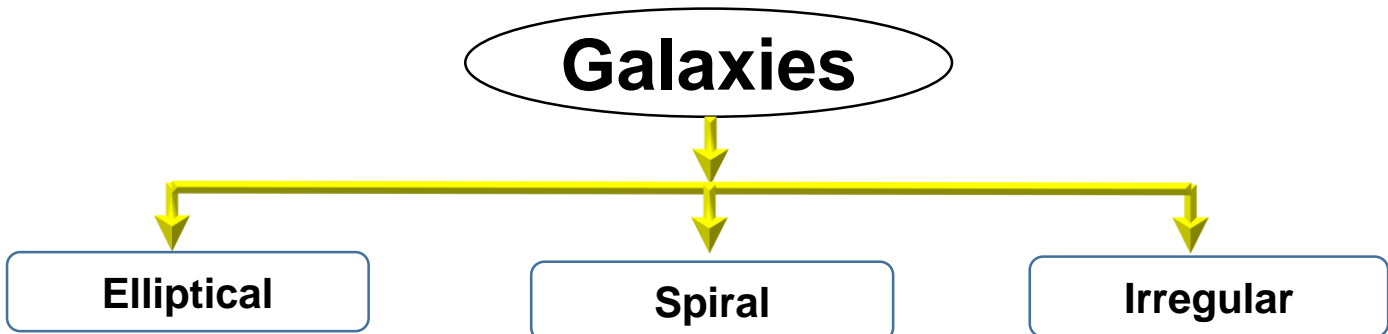
The Sun completes one lap of the galaxy in about every **220 million years**.

The solar system revolves around the Milky Way with a speed of **285 km per second**.

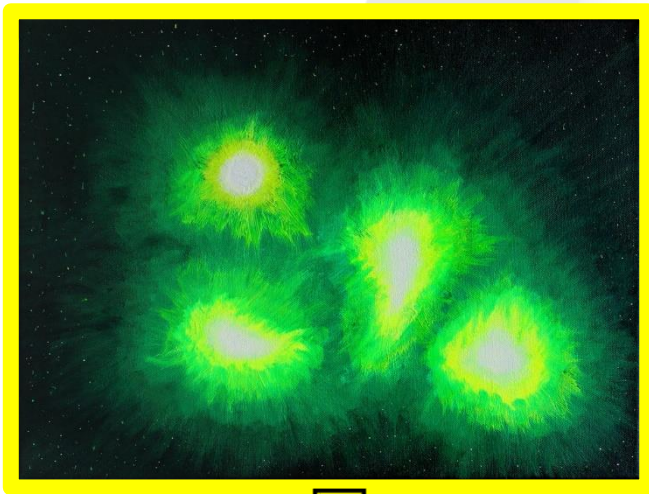


# GALAXY

- Approximately the universe contains  $10^{11}$  galaxies and an equal no. of stars in each.
- **Lyman Alpha blobs** - These are largest clusters of heavenly bodies found in the universe.



**Lyman Alpha Blobs**



Largest and biggest celestial bodies formed of galaxy clusters,

**The Milky way**

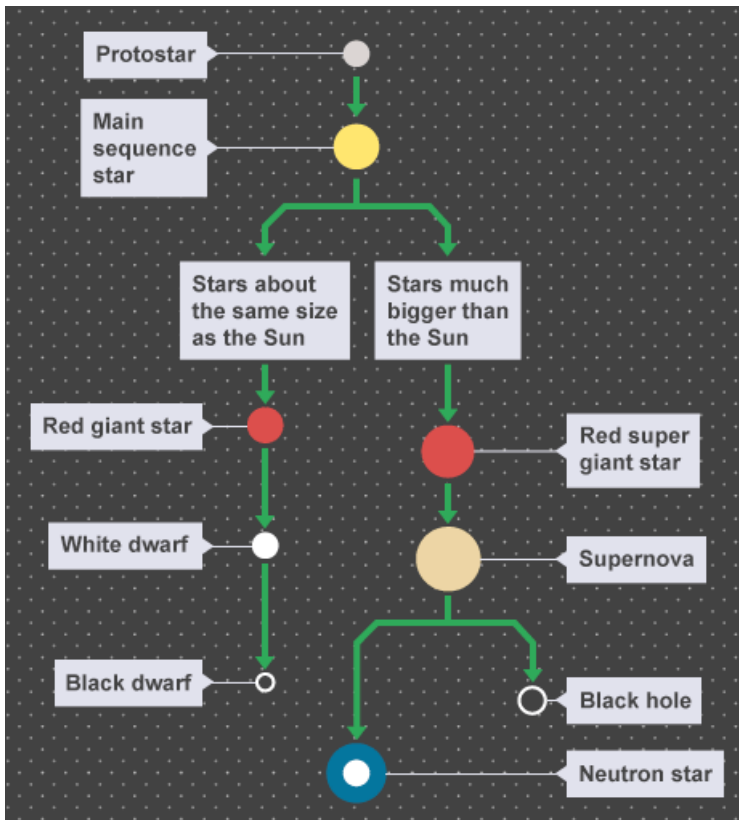


Our Galaxy the Milky way. The solar system lies in one of its arms.

## IMPORTANT FACTS

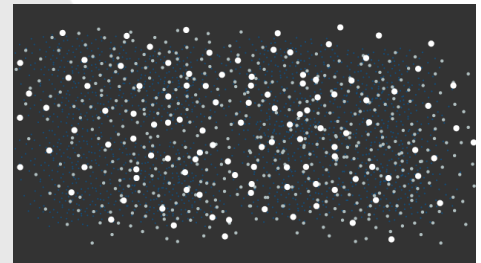
- **Proxima Centauri** – Closest star of solar system (4.2 light years away).
- **Alpha Centauri** – Second closest star of solar system (4.3 light years away).
- **Barnard's Star** - Third closest star of solar system (5.9 light years away).
- The **Andromeda** Galaxy is the closest galaxy (spiral) to us – being 2 million light years away.
- The brightest star outside our solar system is **Sirius**, also called the **Dog Star**.
- Orion Nebula : The brightest part of our galaxy.

## STAR FORMATION (STELLAR EVOLUTION OR LIFE CYCLE OF A STAR)

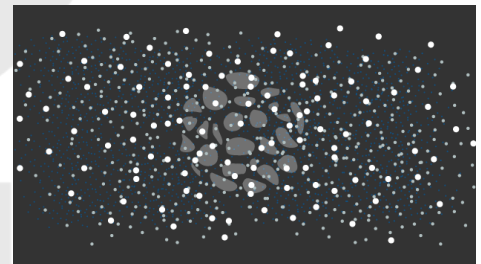


## NEBULA

- A nebula is a giant cloud of gas (mostly hydrogen and helium) and dust in space.
- Turbulence deep within these clouds gives rise to knot with sufficient mass that the gas and dust begins to collapse under its own gravitational attraction.
- Nebulae are the birthplaces of stars.



Nebulae are mostly composed of hydrogen.



Gravity begins to pull the dust and gas together.

## PROTOSTAR



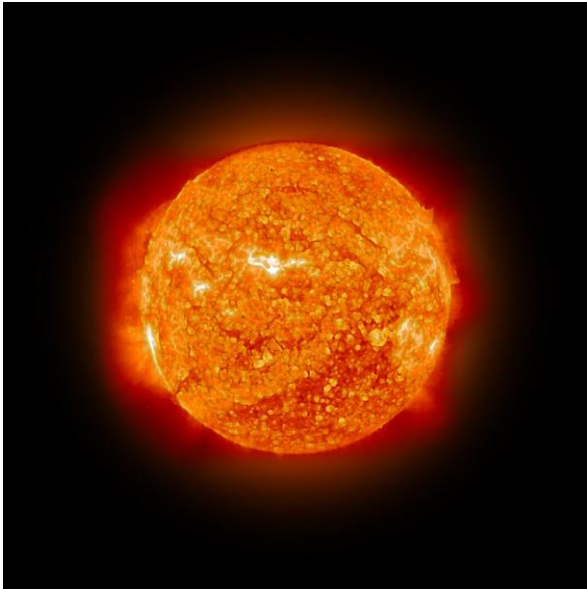
- As the cloud collapses, materials in the centre begins to heat up. This is known as a **Protostar**.
- A Protostar looks like a star, but its core is not yet hot enough for nuclear fusion to take place.

Nuclear Fusion: the fusion of 2 hydrogen atoms into a helium atom with the liberation of a huge amount of energy. Nuclear fusion occurs only when the initial temperatures are very high - a few million degree celsius. That is why it is hard to achieve and control).



# T TAURI STAR

- A very young, lightweight star, less than 10 million years old, that it still undergoing gravitational contraction.
- It represents an intermediate stage between a Protostar and a low-mass main sequence star like the Sun.

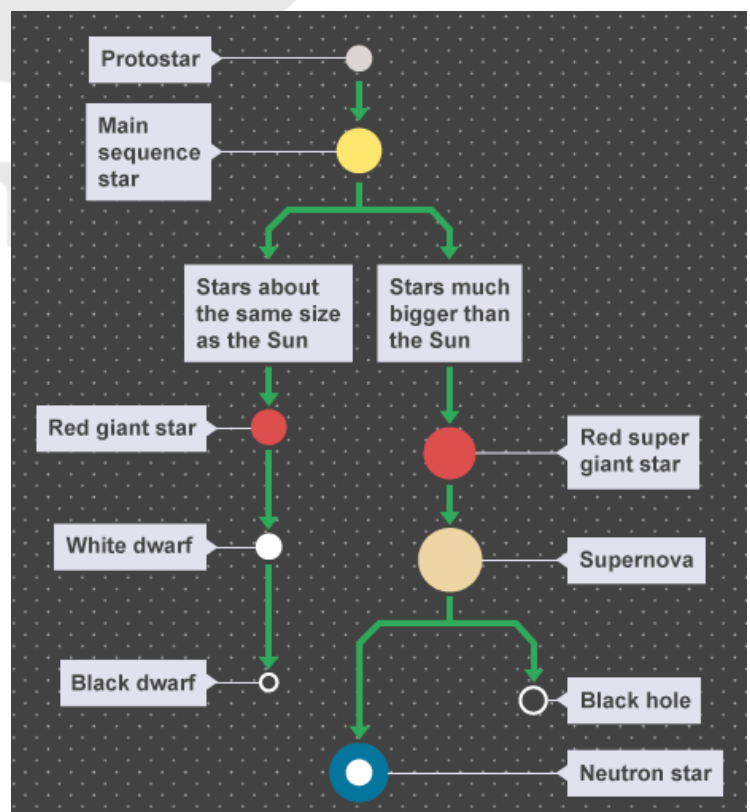


## MAIN SEQUENCE STARS

- Main sequence stars are stars that are fusing hydrogen atoms to form helium atoms in their cores.
- Most of the stars in the universe — about 90 per cent of them — are main sequence stars.
- The Sun is a main sequence star.
- Towards the end of its life, a star like the Sun swells up into a red giant, before losing its outer layers as a planetary nebula and finally shrinking to become a white dwarf.

Parchan

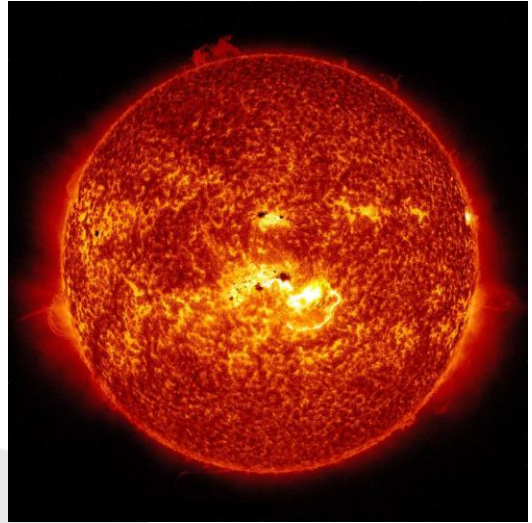
- After the Main Sequence Star, the stars follow different pathways according to their size.



# STARS ABOUT THE SAME SIZE OF THE SUN

## RED GIANT

- When a star has fused all the hydrogen in its core, nuclear reactions cease.
- Deprived of the energy production needed to support it, the core begins to collapse into itself and becomes much hotter.
- Hydrogen is still available outside the core, so hydrogen fusion continues in a shell surrounding the core.
- The increasingly hot core also pushes the outer layers of the star outward, causing them to expand and cool, transforming the star into a red giant.



## PLANETARY NEBULA

Planetary nebula is an outer layer of gas and dust that are lost when the star changes from a **red giant** to a **white dwarf**.



## WHITE DWARF

- When all the nuclear reactions are over, an average star like the Sun may begin to contract under the pull of gravity.
- The star becomes a white dwarf and starts to cool down. For that its colour fades and changes.
- White dwarfs are the remains of normal stars, whose nuclear energy supplies have been used up.
- White dwarf consists of degenerate matter with a very high density due to gravitational effects, i.e. one spoonful has a mass of several tonnes.

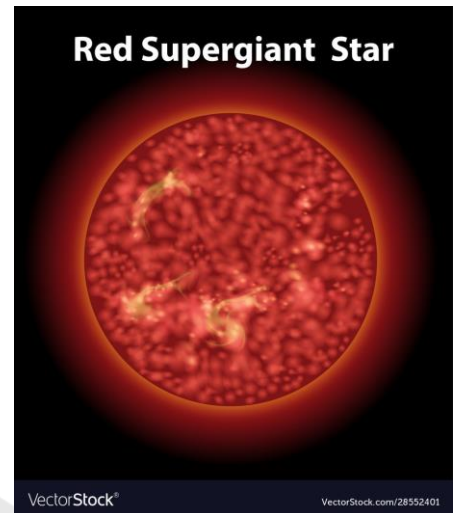
## BLACK DWARF

- The last stage of stellar evolution is a black dwarf.
- A black dwarf is a white dwarf that has sufficiently cooled that it no longer emits significant heat or light.
- Because the time required for a white dwarf to reach this state is calculated to be longer than the current age of the universe (13.8 billion years), no black dwarfs are expected to exist in the universe yet.

# STARS MUCH BIGGER THAN THE SUN

## RED SUPERGIANT

- A very large red giant is often called Red Supergiant.
- As the red giant star condenses, it heats up even further, burning the last of its hydrogen and causing the star's outer layers to expand outward.
- At this stage, the star becomes a large red supergiant.
- They are the largest stars in the universe in terms of physical size, although they are not the most massive.



## SUPERNOVA

- A supernova is the explosive death of a star and often results in the star obtaining the brightness of 100 million suns for a short time.
- The extremely luminous burst of radiation expels much or all of a star's material at a great velocity, driving a shock wave into the surrounding interstellar medium.
- These shock waves trigger condensation is a nebula paving the way for the birth of a new star — if a star has to be born, a star has to die!
- A great proportion of primary cosmic rays comes from supernovae.

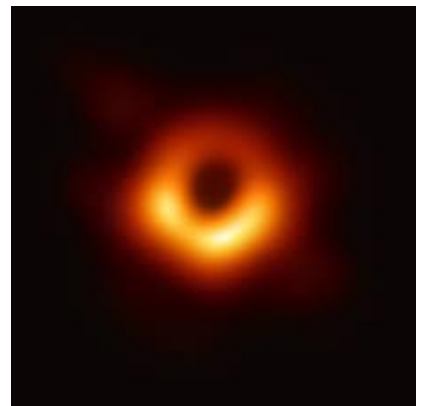


## NEUTRON STARS

- These stars are composed mainly of neutrons and are produced after a supernova, forcing the protons and electrons to combine to produce a neutron star.
- Neutron stars are very dense.
- If its mass is very greater, its gravity will be so strong that it will shrink further to become a black hole.

## BLACK HOLES

- Black holes are believed to form from massive stars at the end of their lifetimes.
- The gravitational pull in a black hole is so great that nothing can escape from it, not even light.
- The density of matter in a black hole cannot be measured (infinite!).
- Black holes distort the space around them and can suck neighbouring matter into them including stars.





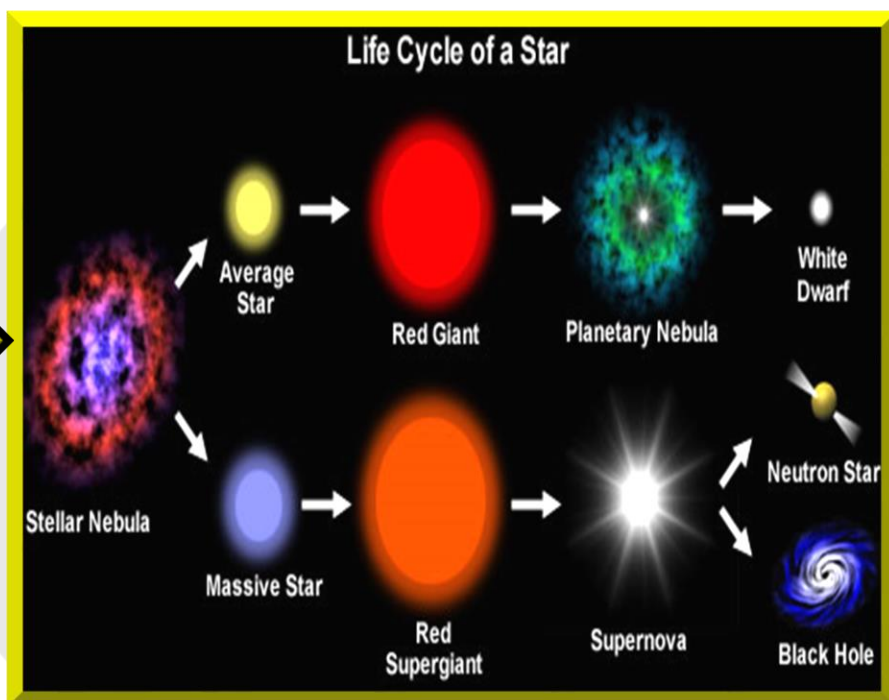
## IMPORTANT FACTS



### Chandrasekhar Limit :

- The **Chandrasekhar limit** is the maximum mass of a stable white dwarf star.
- Subrahmanyan Chandrasekhar was one of the foremost astrophysicists of the twentieth century. He was one of the first scientists to couple the study of physics with the study of astronomy.
- He proved that there was an upper limit to the mass of a white dwarf. This limit is known as the Chandrasekhar limit.

The life cycle of a star is dependent on the Chandrasekhar limit i.e. 1.4 times the mass of the sun. Below this mass a star gets converted to a white dwarf star and beyond this mass the star gets converted to a neutron or black hole.



## Asteroids

- Asteroids are numerous tiny bodies that also move around the Sun apart from the stars, planets, and satellites.
- They are found between the orbits of Mars and Jupiter.

## Meteoroids

- Small pieces of rocks that move around the Sun
- Sometimes they tend to fall on earth
- When the meteoroids fall, they tend to get heated due to friction and burn.
- It causes a flash of light.
- A hollow is created- when the meteor falls on earth without being completely burnt.

# Syzygy

- In astronomy, a syzygy is a roughly straight-line configuration of three or more celestial bodies in a gravitational system.
- When Sun, Moon, and Earth are in the same line, the position is known as the Syzygy.



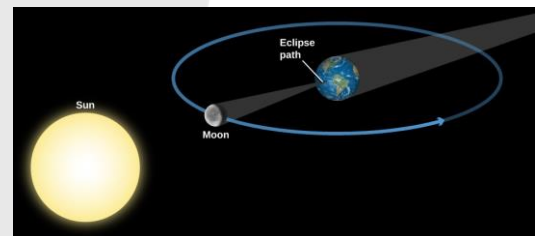
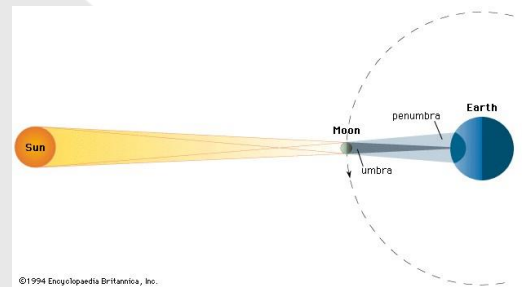
## Eclipses

- An eclipse is the complete or partial obscuring of a celestial body by another other. An eclipse occurs when three celestial objects become aligned.
- Two types of Eclipses are there :
- Solar Eclipse and
- Lunar Eclipse



## Solar eclipses

- Sometimes when the Moon orbits the Earth, the Moon moves between the Sun and Earth. When this happens, the Moon blocks the light of the Sun from reaching Earth. This causes an eclipse of the Sun, or a solar eclipse. During a solar eclipse, the Moon casts a shadow onto Earth.
- It occurs on a no moon day (not on every no moon day).
- Depending on the distance of the moon from the earth during the eclipse, it can be categorized as :-
- Partial solar eclipse,
- Annular solar eclipse and
- Total solar eclipse.



### Partial solar eclipse :

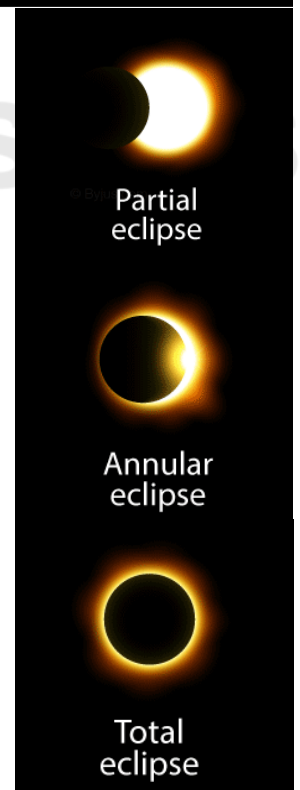
- It happens when the Moon only partially covers the disk of the Sun.
- When the moon does not align completely with the sun and so only a portion of the sunlight is blocked from reaching the earth.

### Annular solar eclipse :

- An annular eclipse happens when the moon is farthest from Earth.
- When the moon covers the sun but the sun can be seen around the edges of the moon giving an impression of the sun in a bright ring surrounding the dark disc of the moon. This ring is known as the ring of fire.

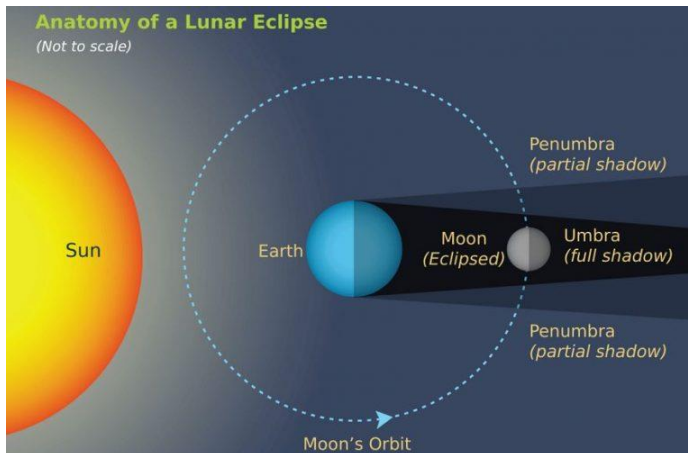
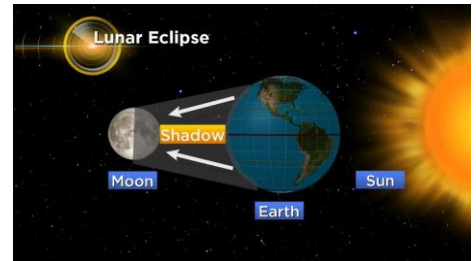
### Total solar eclipse :

- A total eclipse happens when the moon is nearest to the Earth.
- When the sun is completely covered by the moon. The sky becomes so dark that it appears to be night. Only a small area on the earth can witness it.



# Lunar Eclipse

- Lunar Eclipse occurs when the earth comes in between the sun and the moon, i.e, during the opposition syzygy.
- As a result, the earth blocks the light of the sun from reaching the moon's surface and casts its shadow on the moon.
- It occurs on a full moon day (not on every full moon day).
- lunar eclipse too can be categorized as:
  1. Partial lunar eclipse and
  2. Total lunar eclipse.



## Total lunar eclipse :

- In this, the inner part of Earth's shadow, called the umbra, falls on the moon's face.
- At mid-eclipse, the entire moon is in shadow, which may appear blood red.

## Partial lunar eclipse :

- In this, the umbra covers only a fraction of the moon.

Parcham Classes

## Questions

The 'Big Bang Theory' is related to which of the following?

- A. Continental Drift
- B. Origin of Universe
- C. Origin of Himalayas
- D. Eruption of Volcanoes

The Milky Way is classified as\_\_\_\_\_.

- A. Spiral Galaxy
- B. Electrical Galaxy
- C. Irregular Galaxy
- D. Round Galaxy

What does the colour of star indicates?

- A. Distance from the Sun
- B. Lighting or glow
- C. Distance from the earth
- D. Temperature

What is the time taken by the Sun to revolve around the centre of our galaxy?

- A. 2.5 Crore years
- B. 10 Crore years
- C. 25 Crore years
- D. 50 Crore years

Which of the following concept related to the limit beyond stars suffer internal collapse?

- A. Chandrasekhar limit
- B. Eddington limit
- C. Hoyle limit
- D. Fowler limit

Which is the brightest star outside the Solar System?

- A. Sirius
- B. Proxima Centauri
- C. Alpha Centauri
- D. Beta Centaury



Question	Answer
1	B
2	A
3	D
4	C
5	A
6	A



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